

INSTRUCTIONS AND OPERATING MANUAL

FOR

MODEL SA-20

SPECTRUM ANALYZER

VECTRON, INC.

WALTHAM, MASS.



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# SPECTRUM ANALYZER INSTRUCTION BOOK

## SECTION I -- OPERATION

### (A) Brief Description of Model SA-20 Spectrum Analyzer.

The Model SA-20 Spectrum Analyzer is a flexible superheterodyne receiver with a cathode-ray-oscilloscope output indication.

A linear saw-tooth voltage is used to frequency modulate the local oscillator of the r-f head and to provide the sweep voltage for the oscilloscope circuits. As the selective receiver is swept through the spectrum of the incoming signal, the various components of an incoming modulated wave are resolved and appear as vertical pips on the oscilloscope screen.

The i-f amplifier bandwidth determines the attainable resolution of the system. The Model SA-20 Spectrum Analyzer is normally equipped with a 50 kc bandwidth i-f amplifier which will produce good resolution of modulated wave components normally encountered in radar work. For greater resolution, a special i-f amplifier is available. The equipment is designed so that i-f amplifier strips may be interchanged with a minimum of difficulty (a screwdriver is the only tool required). A double conversion system provides a highly stable i-f channel.

The r-f head is easily removable, thus the analyzer is adaptable for a wide range of standard and custom applications. Plug-in heads for the "S" (2400-3650 mcs) and "X" (8500-9600 mcs) radar bands are available. Special r-f heads for other applications are planned and can be designed to augment the presently available heads.

The Model SA-20 Spectrum Analyzer has a wide variety of uses such as: analysis of spectra of pulsed oscillators, detection of moding and instability in microwave oscillators and transmitter equipment, measuring standing waves and attenuation, measuring frequency, and analyzing AFC and magnetron pulling. The construction and design in this equipment provides a high degree of reliability in combination with

excellent mechanical and electrical stability. The equipment, therefore, is well suited to production testing operations as well as laboratory measurement and analysis.

The equipment will operate from 100-120 volts, 60 cycle current.

(B) Installation, Initial Adjustment and Operating Precautions.

After unpacking, the unit should be inspected externally and internally (by removing side and back panels) for possible damage in shipment. Tubes, which may have become loosened in transit, should be re-seated. All plug connectors should be tightened if loose. The unit is shipped complete with all tubes and is ready for operation.

Front-panel-control references are capitalized in the following descriptions. Set METER Switch S205 to CATHODE and then turn power Switch S201 to ON. Allow a minute or two for the unit to warm up. During the warm up, constantly observe the meter current. If the current drives the meter off scale, shut the equipment down for a few minutes by turning power Switch S201 to OFF. Remove the repeller saw-tooth voltage by turning FREQUENCY SPREAD Control clockwise and make the repeller voltage most negative by turning REPELLER VOLTAGE Control fully clockwise. If the meter current is again driven off scale by a subsequent warm-up, this is an indication of a defective Klystron tube. Replacement should be made by following the instructions given in Section III.

If the equipment is functioning normally, the meter current will read approximately 1/2 full scale or slightly more in the case of the S-band head, and will read approximately 1/2 full scale or slightly less in the case of the X-band head. As the current in the meter starts to rise, the Klystron tube can be checked for operation by rotation of REPELLER VOLTAGE Control. Small increases in meter current which occur at one or more positions as the control is rotated, will indicate an oscillating condition. The increase of the meter current will not be extreme but will be sufficiently pronounced to be able to

definitely detect the repeller control points where oscillation starts and ceases. A shunt is connected across the meter so that it reads 45 ma full scale when METER Switch is in CATHODE position.

The horizontal sweep amplitude is dependent upon the presence of Klystron current and will appear restricted until full warm up of the Klystron has taken place.

The two d-c power supply voltage regulator adjustments which are located on the vertical electronic chassis are nominally set to +250V and -300V with a meter. A tube change in the power supply may require a readjustment of these controls (R210 or R220). Extreme line voltage variation could cause a loss of regulation. The regulator adjustments should be set to maintain regulation over the expected range of line voltage variation. After setting the nominal values by meter, the latter adjustment may be made by tuning R210 and R220 for minimum ripple as the line voltage is adjusted over its expected range. A high-gain oscilloscope may be used to indicate ripple.

### (C) Preliminary Adjustment Tests.

#### (1) Performance Test of Sweep and Cathode Ray Oscilloscope Circuits.

Test the operation of VERTICAL, HORIZONTAL, INTENSITY, FOCUS, SWEEP AMPLITUDE and SWEEP FREQUENCY Controls and adjust them for proper centering and trace production on the oscilloscope screen.

An astigmatism correction adjustment is located above the cathode ray tube socket on the front side of the rear chassis. The control is factory adjusted for the particular tube supplied with the equipment. This control is accessible when either side of the analyzer is removed. Replacement of a cathode ray tube will necessitate a readjustment of this control. When the astigmatism control is properly adjusted, variation of FOCUS Control should cause the spot to change only in size and not shape. When SWEEP AMPLITUDE and SIGNAL GAIN Controls are at zero, (fully counterclockwise) a single spot will

appear on the oscilloscope screen. Adjust INTENSITY Control so that the spot is of medium intensity. The astigmatism control should be experimentally adjusted so that minimum distortion of the spot is obtained during the variation of FOCUS Control. This adjustment provides for good focus over the useful portions of the oscilloscope tube. This condition may be checked either by moving the spot over the tube face by VERTICAL and HORIZONTAL Control manipulation or by viewing an actual spectrum.

If it is found desirable to increase the sweep frequency, this may be accomplished by opening one connection of C223. If, for example, 1 mfd capacitor is connected in series with this capacitor the sweep frequencies will be doubled. Also, the sweep frequency may be lowered by shunting C223.

## (2) Performance Test of the Signal Path.

A preliminary check of the r-f head may be instituted by observing the crystal current wave produced by the frequency modulation of the local oscillator. When a frequency marker or signal generator is available, it may be used as a test source by observing its pips or spectra on the screen.

With METER Switch on CATHODE, SIGNAL Switch on CRYSTAL, and FREQUENCY SPREAD Control fully counterclockwise, adjust REPELLER VOLTAGE Control until a "U", or inverted "U", shaped curve is observed on the oscilloscope screen. This curve is the mode curve of the oscillator. It is often possible to obtain two or more mode curves over the rotation range of the REPELLER VOLTAGE Control, particularly with the X-band head.

It may be necessary to adjust OSCILLATOR COUPLING Control in order to obtain proper crystal current (throw METER Switch to CRYSTAL). The coupling adjustment should be made to produce 1/3 to 1 2 scale deflection of the meter with FREQUENCY SPREAD Control in full clockwise position (minimum frequency sweep). As in any superheterodyne receiver, the mixer current is not critical as long as local

oscillator injection is large compared with the signal received.

Center one of the observed modes on the screen by adjustment of REPELLER VOLTAGE Control and broaden or narrow it to a convenient viewing size by adjustment of FREQUENCY SPREAD Control. This condition indicates proper operation of the mixer and proper adjustment of the local oscillator.

Final check should be made by signal injection and spectra observation. Crystal current is not critical as long as the display of signals is satisfactory and the three quarter scale meter reading is not exceeded.

#### (D) Operating Controls.

VERTICAL provides adjustment of the vertical position of the trace by control of the d-c voltage on the cathode ray tube deflecting plates.

HORIZONTAL provides adjustment of the horizontal position of the trace by control of the d-c voltage on the cathode ray tube deflecting plates.

INTENSITY provides adjustment of the beam current of the cathode ray tube and the brilliance of the trace by the control grid of the cathode ray tube.

FOCUS provides adjustment of the sharpness of the trace line by control of the d-c voltage on the first anode of the cathode ray tube.

SYNC AMPLITUDE provides adjustment of the "lock-in" of the trace by control of the sync signal amplitude applied to the sweep oscillator grid.

SYNC SELECTOR provides for selection of the sync signal source. In the EXT position, an external signal connected to the SYNC INPUT binding posts will gain access to the sweep oscillator grid via the SYNC AMPLITUDE Control. In the INT position, the demodulated signal from the infinite impedance detector at the end of the i-f amplifier will gain access to the grid of the sweep oscillator via the SYNC AMPLITUDE Control. In the LINE Position, primary a-c from one of the filament circuits will be applied to the grid of the sweep oscillator via the SYNC

## AMPLITUDE Control.

SWEEP FREQUENCY provides adjustment of the free-running frequency of the saw-tooth oscillator. By means of this control, the frequency of the sweep applied to the local oscillator and the deflection plates of the cathode ray tube may be varied from approximately 10 to 30 cycles per second

FREQUENCY SPREAD provides adjustment of the width of the range over which the local oscillator is swept. This control action is accomplished by amplitude control of the sweep voltage applied to the local oscillator repeller.

SWEEP AMPLITUDE provides adjustment of the horizontal dimension of the trace on the oscilloscope screen by horizontal amplifier gain control.

SIGNAL GAIN provides adjustment of the superheterodyne receiver sensitivity by control of the plate and screen voltages on two of the i-f amplifier stages.

REPELLER VOLTAGE provides adjustment of the negative value of the d-c voltage applied to the repeller electrode of the local oscillator. This control is used to set the tube to the desired mode of oscillation.

OSCILLATOR COUPLING provides adjustment of the local oscillator injection voltage by control of the coupling coefficient between mixer and local oscillator. This control allows readjustment of the injection voltage when tuning over an extended frequency range.

The main tuning control is located in the center of the r-f head, directly below the meter. Vernier dial adjustment is provided in addition to the rotation counter readings. The calibration of the dial and counter readings is given in the chart provided with S-band heads. The X-band head has a built-in frequency meter. Calibration of the frequency meter is given by a chart included with the equipment. The main tuning control is an oscillator frequency control and the calibration therefore corresponds to the oscillator frequency and not the incoming signal frequency. Calibration will change with oscillator tube

replacement. Clockwise rotation of the main tuning control increases the oscillator frequency.

The power switch is located on the fuse box panel, which will be found at the bottom center position in the front of the equipment. A jewel light indicator, provided on this panel, lights when power is supplied to the input winding of the power transformer.

ATTENUATOR 1 and ATTENUATOR 2 control the position of the coupling loop in the waveguide-below-cutoff attenuator. The attenuator dials are graduated from 0 to 100 with a calibration of approximately 1.0 db/div. above division 20.

#### (E) Miscellaneous Adjustments and Precautions.

The SIGNAL GAIN Control and the ATTENUATOR Control should be adjusted to the point where noise on the signal is negligible, the image on the oscilloscope is of a convenient size and the crystal current is at proper value. Normally, the ATTENUATOR can be operated in its linear range (above div. 20) and the SIGNAL GAIN Control can be set to give a convenient amount of deflection without encountering appreciable quantities of noise on the oscilloscope presentation.

Too little r-f attenuation may be dangerous under pulsed conditions. With c-w input, the meter in the crystal circuit may be used to indicate a safe value of current (half scale or less). With a pulsed input, the peak current may rise to a dangerous level without an appreciable increase in the meter reading. Since crystal burn-out is a definite possibility under pulsed conditions, sufficient attenuation must be provided at all times.

Tabulation follows for the attenuation in db per division, above division 20, at 3 frequencies in each tuning range. The variation in attenuation over the tunable r-f range is so slight (less than 1%) that for most work it may be taken as 1 db per division, above division 20. For very precise measurement, the formula given below may be applied to arrive at the exact value of attenuation, above division 20, for any particular frequency. The end effects of the waveguide-below-

cutoff attenuator produce considerable non-linearity below division 20. Wherever possible, measurements should be carried out above division 20.

### Formula for Waveguide-Below-Cutoff Attenuator

To determine the attenuation in db per division at some r-f frequency

$$A = \pi x (P.D.) x \frac{270}{360} x \frac{.545}{\lambda_c} \sqrt{1 - \left(\frac{\lambda_c}{\lambda}\right)^2}$$

where A = attenuation in db per division, above division 20.  
 $\lambda_c$  = cutoff wavelength = 1.706 x I.D. of attenuator tube.  
 $\lambda$  = operating wavelength  
P.D. = pitch diameter of pinion gear (pinion gear effects linear travel of attenuator probe by means of rack movement).

Sample Tabulation from application of above formula

S-Band Attenuator (I.D. of Attenuator tube = .497", P.D. = 0.666")

<u>Freq. in Mc</u>	<u>A</u>
2400	.995
3000	.988
3600	.976

X-Band Attenuator (I.D. of Attenuator tube = .338", P.D. = 0.500")

<u>Freq. in Mc</u>	<u>A</u>
8500	1.014
9050	1.002
9600	.987

An alternative method for checking relative attenuation is to use the oscilloscope indication. Presentation on the screen is linear in power when the image size is held to less than three inches. The vertical spacings on the instrument screen are helpful in this respect since factors of 2 (3 db) may be easily determined. If desired the strong parts of the signal can be distorted in order to view the weaker side bands. This may be done by increasing the gain. The clipping affects only signal components exceeding 3 inches deflection. The horizontal markings of the oscilloscope scale can be converted to

frequency indications by detuning the local oscillator when viewing a reference signal and referring to the calibration chart of the local oscillator. If the pulse duration of the signal is known, the location of the zero points will give approximate frequency data. Alternatively, external frequency data can be used for calibration of the scale.

Attenuator dial readings refer to approximate db attenuation of signal input to mixer.

#### (F) Input Connections.

A power cord is provided in the rear of the unit. This cord is provided with a ground wire which is attached to the frame of the instrument. Two fuse holders may be found on the front of the instrument, one is a power fuse (5A.), the other a spare power fuse. Also the analyzer employs fuses in the B. supplies. These fuses will be found by removal of the rear skin of the equipment.

The SYNC INPUT binding posts are located on the fuse box panel (lower center of the front panel). These binding posts are used for the introduction of external sync voltage to the saw-tooth oscillator. The sync selector switch must be set to EXT to connect the sync input terminals to the saw-tooth oscillator. The INT position is available for special conditions of synchronizing, but is not ordinarily used.

INPUT 1 and INPUT 2 of the S-band head and INPUT of the X-band head are coaxial input receptacles for external signals. Signals may be simultaneously introduced to both input terminals of the S-band head with individual attenuation control. The dual input feature of the S-band head will find application for such things as comparing two unknown frequencies, the application of a marker generator to an unknown incoming frequency, r-f bridge measurements, standing wave measurements, etc.

## SECTION II -- CIRCUITS

### (A) General Description.

Reference to figure 2 will show the analyzer states in block diagram form.

The signal to be analyzed is applied to the input connector of the r-f head. An adjustable waveguide attenuator is interposed between the signal input and the crystal mixer.

The local oscillator, a reflex Klystron, is adjustably coupled to the mixer.

The initial i-f amplifier stage is centered at 22.5 mc and the second i-f stage acts as a converter to 3 mc. The third and fourth i-f stages are centered at 3 mc while the following stage is an infinite impedance detector.

The indicator section contains an oscilloscope tube for visual presentation of the incoming signal. The vertical and horizontal amplifiers contain phase splitters so that push-pull deflection is obtained. The detected signal, the oscillator mode signal, and the wavemeter impulse are fed to the vertical amplifier. The oscillator mode signal and the wavemeter impulse are taken from the d-c connection of the crystal mixer. Switch A of the block diagram is representative of the SIGNAL Switch in the equipment in that it provides access to the oscillator mode signal at will. The relatively short impulse created by the presence of a frequency meter is sharpened by the use of a differentiating amplifier. A frequency meter "spike" indication will then be observed on the visual presentation. Switch B of the block diagram represents a method described in Section II (D) for nullifying the action of the differentiating amplifier. With switch A and B open, the vertical amplifier receives only the demodulated incoming signal from the infinite impedance detector. The intensification circuit operates from the output of the vertical amplifier and is used to brighten the trace on the cathode ray tube when signal pulses appear. The saw-tooth oscillator of the indicator section generates a sweep voltage for the horizontal plates of the cathode

ray tube and a modulating signal for sweeping the local oscillator of the r-f head. Individual and adjustable amplifiers render independent control of the two functions of the saw-tooth oscillator.

A blanking circuit, actuated by the saw-tooth oscillator, acts to blank out the cathode ray tube trace during the return period.

The two regulated low-voltage power supplies obtain their a-c potentials from separate windings on a common power transformer which also supplies all heater requirements of the analyzer.

An oscillator, powered from the positive regulated d-c supply, actuates a high voltage transformer. Negative and positive rectifiers operate from a common secondary winding to produce the high voltage for the indicator.

With the i-f amplifier acting as the resolving means, the local oscillator is swept through a frequency range in synchronism with the horizontal beam deflection of the cathode ray tube. The output transient of the i-f amplifier associated with each input pulse is fed through amplifiers to the vertical deflection plates. During the sweep, the transients appear as vertical pips of varying height on the cathode ray tube screen. The incoming spectrum will thus be presented in a graphic manner, power vs. frequency, across the face of the oscilloscope tube.

## (B) R-F Section.

### (1) General.

The r-f sections of the Model SA-20 Spectrum Analyzer are designed for complete interchangeability. Plug-in r-f heads are available for the S-band (2400-3650 mcs) and the X-band (8500-9660 mcs). Interchangeable heads can be designed for other than the standard ranges mentioned above.

The S-band head uses a type 707B local oscillator tube and the X-band head uses a type 2K25 local oscillator tube. The schematic diagram of the S- and X-band heads are shown in Figure 4. The convenience and accessibility of the r-f head plumbing will become evident in the maintenance description(SECTION III).

The grids and cavity of the reflex-Klystron local-oscillator are all grounded. All other electrode voltages applied are negative with respect to ground. A regulated accelerating voltage of 300 volts is provided. The repeller voltage can be varied from -50 to -150 volts with respect to cathode. An adjustable saw-tooth voltage is used for frequency modulating the local oscillator and is superimposed on the d-c repeller control voltage. This voltage has a peak-to-peak value of approximately 80 volts. The saw-tooth voltage is balanced with respect to the d-c repeller voltage so that the frequency spread control will not cause appreciable displacement of the signal from the center of the oscilloscope screen.

The oscillator injection voltage into the crystal mixer is knob-controlled from the front panel of the r-f head. In the case of the S-band head, a coupling loop is rotated; in the case of the X-band head a screw, which projects into the coupling orifice, is varied. The OSCILLATOR COUPLING Control is relatively non-critical and requires little use.

External signals are normally injected into the mixer circuit through an attenuator of the waveguide-below-cutoff type. Two input connectors are available on the front panel of the S-band head and one input connector is provided on the panel of the X-band head.

## (2) S-Band Head (See Figures 4 and 6).

The cavity block of the Klystron is provided with two outputs. As a matter of convenience, the bottom cavity output is used to feed the crystal mixer. The Klystron output on the top of the cavity block may be used for auxiliary service. The auxiliary cavity output frequency is that of the local oscillator and corresponds directly to the calibrated value of the main tuning control. The equipment can be employed as a signal generator under such conditions.

The mixer and attenuator assembly is located directly below the Klystron cavity. The crystal mixer is located at the junction of the long and short waveguides of this assembly, and the crystal itself is accessible upon removal of the output connector. The long tubes of the

assembly are the waveguide-below-cutoff attenuators and are adjustable from the front panel. The short tubes are direct inputs. The crystal mixer, therefore, has four inputs. The coaxial cable from the Klystron cavity normally connects into one of the direct inputs; the other is free for auxiliary service. The coaxial connectors, available at the front panel, normally connect via coaxial cables to the two attenuator inputs. For special purposes, the transmission line of one of the front panel input connectors could be transferred to the auxiliary direct input. Connectors are provided at the end of the transmission lines to facilitate transfer.

To the rear of the direct input connectors is the coaxial output and this is connected to the i-f amplifier input via a coaxial cable.

### (3) X-Band Head (See Figures 4 and 7).

The oscillator cavity joins the attenuator and crystal mixer cavity by a coupling orifice. The INPUT receptacle on the front panel connects through a coaxial cable to the attenuator. The output receptacle is located on the waveguide plumbing directly above the frequency meter. The coaxial cable from the output receptacle connects the crystal mixer to the i-f amplifier input. The crystal itself is replaceable and is accessible by removal of the cap opposite the output connector.

### (C) I-F Section.

The intermediate-frequency signals produced in the output of the crystal mixer are introduced directly to the input transformer of the i-f amplifier. It may be observed on the schematic that there is a return connection for d-c crystal current through the input transformer primary, and that a powdered iron slug is employed in the coaxial connector of the i-f amplifier. The powdered iron slug acts as an r-f filter between the mixer and the i-f amplifier. The filtered line from the primary of the i-f strip input transformer allows metering of crystal current and visual observation of local oscillator mode curves and frequency meter

differentiated pips.

The first i-f amplifier stage is relatively broad (approximately 150 kcs) and is centered at 22.5 mcs. Immediately following this stage a second local oscillator at 19.5 mcs converts the signal to 3 mc. The 3 mc i-f stages which follow have a bandwidth of 50 kc. The choice of the input frequency of 22.5 mcs is dictated by the desire to suppress image response that might give false spectra indications on carrier modulation involving very short duration pulses (in the vicinity of  $0.2\mu$  sec.). The bandwidth of the i-f amplifier, which is 50 kc wide at the  $1/2$  power points, is dictated by the desire to resolve the modulation components of the longer pulses (in the vicinity of  $2\mu$  sec.). The important side bands of the long pulses are grouped close to the carrier and a circuit of relatively sharp selectivity is therefore needed to resolve the individual spectra components. Since it is difficult to produce a stable 22.5 mc amplifier which has a 50 kc bandpass characteristic, the double superheterodyne action is used in order that no sacrifice in stability, selectivity or image rejection is imposed. For pulses longer than  $2\mu$  sec., a narrower i-f bandwidth amplifier should be used.

When properly aligned, the signal-to-noise response of the amplifier is sufficient to discern a  $1/2 \mu\text{v.}$  signal.

#### (D) Indicator Section.

A push-pull phase-inverting amplifier stage, V213, is used between the single-ended infinite-impedance detector and the vertical plates of the cathode ray oscilloscope tube. The pulse shape of the signal transients is determined by the i-f amplifier characteristic and is not appreciably affected by the vertical amplifier.

The horizontal sweep voltage is generated by a conventional type of thyatron relaxation oscillator, V214, which provides a nominal range of 10 to 30 cps. A positive blanking pulse is also derived from this source so that the cathode ray tube beam is prevented from illuminating the screen on its return trace. The horizontal sweep voltage is directly coupled from the thyatron to a phase-splitter which drives the

push-pull horizontal amplifier. The sweep voltage developed across part of the cathode load of the phase-splitter is amplified by V215B, and is applied to the repeller of the Klystron local oscillator to produce the required frequency modulation. R401 or R301 of the r-f head is used to control the amplitude of the sweep voltage applied to the Klystron.

The triode V212B, connected to the negative-going plate of the vertical amplifier, is used for cathode-ray-tube intensification. The leading edge of a signal drives this tube into cut-off and the resulting positive voltage produced in its plate circuit is fed to the cathode ray tube grid. The negative pulse, produced in the cathode of V212B, is fed to the focusing electrode of the cathode ray tube to retain focus during intensification of the sharp spikes of a pulsed spectrum.

V105B and V212B constitute an amplifier which is used for viewing the frequency meter spike when a frequency meter is used. The d-c signal from the mixer crystal is applied to the grid of V105B but the mode curve is not produced on the viewing screen due to the short time constant of the intervening amplifier circuits. The spike produced in sweeping across the frequency meter produces a differential change which is amplified and applied to the vertical deflection circuits. By throwing SIGNAL Switch to CRYSTAL, the mode curve can be observed through the regular circuit together with the superimposed wavemeter spike produced through V105B and V212B. With SIGNAL Switch in NORMAL position, the wavemeter spike will be observed to be superimposed upon the incoming spectra. The rise and fall of the mode curve will produce signal voltage in the differentiating amplifier. Corresponding spikes will then appear in the oscilloscope trace. These spikes may be objectionable under certain conditions. When frequency meter indication is not used or is not needed, the input to the differentiating amplifier may be shorted to eliminate the spike indication. A convenient way to accomplish this is either to place a jumper between terminals 2 and 5 of the i-f amplifier barrier strip E101, or to simply remove the spade connector from the number 5 terminal.

(E) Power Supplies.

The following d-c voltages are produced by the power supplies of the system: -5V, -300V, -450V, +250V and +150V regulated, +420 unregulated, and -1200V and +1800V which are indirectly regulated.

The regulated negative voltages and the regulated positive voltages are obtained from separate rectifier and regulator circuits which operate from a common power transformer T201. The unregulated +420V is taken ahead of the regulator circuit in the positive supply. The indirectly regulated high voltages of +1800 and -1200 volts are each obtained through separate rectifiers which are energized by a common oscillator V209 and transformer T202. A self-excited audio oscillator is used to drive the high voltage power transformer. The anode voltage of the V209 oscillator tube is voltage regulated, this feature serving to eliminate annoying intensity fluctuations and pattern shifts that might otherwise be observed on the cathode ray tube.

### SECTION III -- MAINTENANCE

#### (A) Cautions.

Cathode ray tube operation involves potentials as high as 1800V with respect to the chassis and as high as 3000V point-to-point. Caution should therefore be exercised during servicing operations.

The repeller, cathode and heater of the Klystron have a high negative voltage in respect to the chassis and these terminals are a potential source of shock. In service work, care should be taken not to short circuit these terminals to the chassis, otherwise the tube might be damaged.

#### (B) Use of Schematic Diagram and Photographs.

The schematic diagram is given in Figure 3. The front panel controls are shown in Figure 1 and the adjustments described in Section I (C) and I (D) are labeled on the schematic. Figures 6 and 7 call out the physical parts of major importance on the r-f heads. Figures 8 and 9 call out the important parts of the indicator chassis.

The parts list gives a further breakdown of the values indicated on the schematic diagram.

#### (C) Trouble Shooting.

In the case of equipment failure, the first attempt should be to localize the trouble to a certain portion of the equipment. When failure occurs, the B supply fuses (remove rear skin) should be checked if front panel primary fuse is not blown.

Trouble peculiar to the indicator circuits may often be isolated to a certain circuit by operating the scope controls. For example, inability of a control to properly focus or to properly center the image would indicate drifted component values or leaky coupling capacitors. The schematic diagram may then be referenced for detailed circuit checks with a multimeter or a vacuum tube voltmeter.

Trouble peculiar to the signal action can often be isolated by

varying the r-f controls such as the ATTENUATOR, main tuning, REPELLER VOLTAGE, OSCILLATOR COUPLING and SIGNAL GAIN while noting the effect on the image.

If the crystal mode curve can be observed and no spectra can be observed, input connections, attenuator circuit, and i-f amplifier continuity should be individually checked for failure. Failure to obtain the mode curve or the spectra indication would indicate failure of the r-f section. In such a case, the crystal current or oscillator current may serve to indicate the general source of difficulty.

When insufficient sweep width is evident, a normal assumption would be that the saw-tooth oscillator or subsequent amplifier stages were defective. While this could be the case, insufficient or no Klystron current could also cause such an indication through loss of regulation of the common power supply. Therefore, it is well to check the Klystron current by throwing METER Switch to CATHODE before making detailed tests on the saw-tooth circuits.

#### (D) Voltage Chart.

The following voltages when read with a 20,000 ohms/volt meter are typical of those which may be found in the equipment. Reasonable leeway from the typical values given here may be expected in normal operation of the equipment. The power supply voltages are given on the schematic diagram.

#### Power Supply Section

T201	S <sub>1</sub> (pins 4 and 6 of V201)	750V a-c
	S <sub>2</sub> (pins 4 and 6 of V202)	975V a-c
V205	Pin 5	+190V
V206	Pin 6	-220V
V204	Pin 6	+200V

### Vertical Amplifier and Intensification Circuits

<u>V213</u>	Pin 1	SIGNAL Switch	(Normal)	+250V
			(Crystal	+115V
	Pin 3	SIGNAL Switch	(Normal	+3.3V
			(Crystal	+0.7V
	Pin 6	SIGNAL Switch	(Normal	+115V
			(Crystal	+110V
<u>V212</u>	Pin 8			+ 17V

### High Voltage Oscillator

<u>V209</u>	Pin 1		-18V
	Pin 2		+2.5V
	Pin 6		+225V

### Saw-tooth Circuits

<u>V214</u>	Pin 7		+ 26V
<u>V215</u>	Pin 1		+220V
	Pin 3		+27V
	Pin 6		+80V
	Pin 8		+11V
<u>V216</u>	Pin 1		+150V
	Pin 3		+10V
	Pin 6		+150V

### I-F Strip

(Short-circuit input connector to ground) Gain Control maximum clockwise.

<u>V101</u>	Pin 5		+95V
	Pin 6		+95V
	Pin 7		+0.7V
<u>V102</u>	Pin 1		-4V
	Pin 5		+85V
	Pin 6		+100V

### I-F Strip - continued

<u>V103</u>	Pin 5	+155V
	Pin 6	+38V
	Pin 7	+1.4V
<u>V104</u>	Pin 5	+145V
	Pin 6	+35V
	Pin 7	+0.75V
<u>V105</u>	Pin 1	+145V
	Pin 3	+2.3V

### Wavemeter Pip Circuit

<u>V105</u>	Pin 6 (Can be measured on #5 of I-F Strip terminal board, E101)	+45V
<u>V212</u>	Pin 3	+3.5V

### (E) Instructions for Removal of Klystron Tube in the S-Band Head.

1. Set tuning control to the extreme low-frequency end of the tuning range.
2. Remove end caps A and B on tube housing and remove tube socket (now shown) from tube and top connector C.  
Release wire-clip D by removal of screw E from the bottom of chassis.
3. Remove four screws F from tube housing G and disassemble.
4. Remove half rings H from cavity.
5. Remove four screws I from tube housing J and disassemble.
6. It is normally possible to disassemble housings G and J without removing lug K from terminal L, however, this disassembly can be made where convenience might so dictate.
7. Mark position of rear drive gears M and N with a pencil.  
Loosen the set screw of gear M and remove the gear from Shaft O.

8. Remove end screws P on cavity clamping block Q.  
The screws are accessible through holes provided in end provided in end plate R.
9. If cavity is too tight for easy opening, loosen top screws on cavity block S.
10. Pull cavity apart.
11. Remove Klystron tube T from cavity clamps by exerting a rotary motion together with a gentle outward pulling action.

A new tube should be "worked" carefully into place to ensure the maintenance of proper spring tension of the disc contact without causing damage to either the spring structure or the tube.

A reverse procedure of that described above may be used for re-assembly. It is well, however, to carefully "feel" the structures into place during assembly. Machine screws should be inserted loosely and not tightened until assembly is complete. Part alignment should be checked and carefully readjusted, if necessary, before finally tightening all screws. The M gear should be spring loaded against the N gear. Assemble the M gear while matching the pencil marks previously made. Check gear alignment before the set screw of the gear is tightened on the flat provided on shaft O.

(F) Instructions for Removal of Klystron Tube in the X-Band Head.

The procedure for tube removal is as follows:

1. Remove threaded tube housing cover A.
2. Remove Klystron tube hold-down screws B and C.
3. Remove Repeller Electrode Cap D.
4. Loosen the two set-screws on flexible coupling E.
5. Pull gear and shaft assembly F outward to free the flexible coupling E from the frequency adjusting screw head of the Klystron tube G.
6. The Klystron tube G may now be removed like a conventional tube.

In the replacement of a new Klystron tube, the following procedure should be followed:

1. On the early model heads which do not have a stop mechanism, set the main tuning control so that the counter reads 99 and the dial reads 85. On the later model heads which have a stop mechanism, set the dial to zero. The stop mechanism should be set to prevent a dial reading of less than zero. The traveling stop nut I should then be flush against shank J of the dial mechanism.
2. Turn the frequency adjusting screw of the new Klystron tube to the extreme clockwise position (so that the spring leafs are spread to their maximum).
3. Plug the Klystron tube into socket, holding the gear and shaft assembly F outward so that the frequency adjusting screw of the Klystron will clear the flexible coupling E.
4. Rotate gear and shaft assembly F until the flexible coupling E is in a position to properly engage the head of the frequency adjusting screw on the Klystron.
5. Slip the flexible coupling in place over the head of the frequency adjusting screw of the Klystron. This is done by rotating and releasing gear and shaft assembly F. When properly seated, the gear of the gear and shaft assembly will be meshed with gear H.
6. Tighten set screws (2) on flexible coupling.
7. Replace and tighten hold-down screws B and C.
8. Replace Repeller electrode cap D.
9. Replace tube housing Cover A.

10. In late model X-band heads which have stop mechanisms, rotate the dial up scale until just before the flexible coupling E begins to jump out of its detent dimples.
11. Lock jam nuts K against the traveling stop nut I.

(G) Removal of Crystal in the S- and X-Band Heads.

The crystal in the S-band head is accessible by disconnection of the coaxial-cable fitting which feeds the i-f amplifier and removal of the threaded receptacle which remains attached to the microwave plumbing.

The crystal in the X-band head is accessible by removal of the threaded cap which is on the bottom of the microwave plumbing directly below the coaxial output connector.

(H) Alignment of the I-F Amplifier.

Replacement of any tube in the i-f amplifier may necessitate re-alignment of the circuits. The procedure for i-f realignment without removal from the analyzer proper is as follows:

1. Set SIGNAL GAIN Control to maximum.
2. Connect the low impedance terminals of a signal generator to the input connector of the amplifier.
3. Connect a scope or VTVM to the output of the amplifier (terminal #8 of the E101 barrier strip).
4. Set the signal generator to 3 mc, 50% modulation at 400 cps, and raise its level until output indication is obtained.
5. Successively tune L106 to L104 for maximum response while readjusting signal generator attenuation so that a standard output of 0.5 volt is obtained.
6. Set signal generator to 22.5 mc using 50% modulation at 400 cps.

7. There will be two points on the oscillator coil (L103) where conversion will take place. Choose the one where the adjustment screw is furthest extended. Trim for maximum while maintaining standard output.
8. Tune L102 for maximum while maintaining a standard output.
9. Tune T101 for maximum output while maintaining standard output. This is a very broad band circuit and after once aligned in the best possible way by instruments, should be re-trimmed under actual operating conditions (pulse modulated carrier) for best signal-to-noise ratio.
10. Re-trim oscillator (L103).
11. When properly aligned, a  $1\mu\text{v}$  carrier with 50% modulation at 400 cps should produce 0.5 volt output, or more. (Measured as per #3 above.)

When searching for trouble in the i-f amplifier strip, the unit should be removed from its shield. The following chart indicates the signal input voltages that should produce a standard output reading of 0.5 volt under proper operating conditions.

<u>Terminal</u>	<u>Signal E in for Std. Output</u>	<u>Signal Gen. Setting</u>
Grid of V104	50 mv	3 mc 50% mod. at 400 cps
Grid of V103	3.4 mv	3 mc 50% mod. at 400 cps
Grid of V101	6.0	22.5 mc 50% mod. at 400 cps
Input Connector	1.0	22.5 mc 50% mod. at 400 cps

NOTE: Connection of signal generator to grid of V102 will detune conversion oscillator.

## SECTION IV -- ELECTRICAL PARTS LIST

### CAPACITORS

SYMBOL	VALUE	DESCRIPTION	TYPICAL MFR'S. PART NO.
C101	36 mmf/500V	Silver Mica	EM, CM-15E-360J
C102	.002 mf/500V	Ceramic	EM, CC-2-202
C103	.002 mf/500V	"	" "
C104	.01 mf/200V	Tubular, Metalized Paper	A, P82
C105	27 mmf/500V	Siler Mica	EM, CM-15E-270J
C106	.002 mf/500V	Ceramic	EM, CC-2-202
C107	.002 mf/500V	"	" "
C108	30 mmf/500V	Silver Mica	EM, CM-15E-300J
C109	.002 mf/500V	Ceramic	EM, CC-2-202
C110	200 mmf/500V	Silver Mica	EM, CM-15E-201J
C111	36 mmf/500V	" "	EM, CM-15E-360J
C112	36 mmf/500V	" "	" "
C113	.01 mf/200V	Tubular, Metalized Paper	A, P82
C114	36 mmf/500V	Silver Mica	EM, CM-15E-360J
C115	.01 mf/200V	Tubular, Metalized Paper	A, P82
C116	200 mmf/500V	Silver Mica	EM, CM-15E-201J
C117	.01 mf/200V	Tubular, Metalized Paper	A, P82
C118	.01 mf/200V	" "	" "
C119	43 mmf/500V	Silver Mica	EM, CM-15E-430J
C120	.01 mf/200V	Tubular, Metalized Paper	A, P82
C121	200 mf/500V	Silver Mica	EM, CM-15E-201J
C122	.01 mf/200V	Tubular, Metalized Paper	A, P82
C123	.01 mf/200V	" "	" "
C124	51 mmf/500V	Silver Mica	EM, CM-15E-510J
C125	.01 mf/200V	Tubular, Metalized Paper	A, P82
C126	200 mmf/500V	Silver Mica	EM, CM-15E-201J

## ELECTRICAL PARTS LIST

### CAPACITORS - continued

SYMBOL	VALUE	DESCRIPTION	TYPICAL MFR'S. PART NO.	
C127	51 mmf/500V	Silver Mica	EM,	CM-15E-510J
C128	.01 mf/200V	Tubular, Metalized Paper	A,	P82
C129	.002 mf/500V	Ceramic	EM,	CC-2-202
C130	.002 mf/500V	"	"	"
C131	.01 mf/200V	Tubular, Metalized Paper	A,	P82
C132	.01 mf/200V	" "	"	"
C133	.01 mf/200V	" "	"	"
C134	.01 mf/200V	" "	"	"
C135	.01 mf/200V	" "	"	"
C136	.01 mf/200V	" "	"	"
C201	4 mfd/1000V	Oil	CD,	T10040
C204	4 mfd/1000V	"	"	"
C205	4 mfd/600V	"	CD,	TLAD6040
C209	4 mfd/600V	"	"	"
C210	.1 mfd/600V	Tubular, Molded Paper	S,	TM-1
C211A, B & C	3X. 25 mfd/600V	Bathtub, 3 sections, gnd. can	CD,	DYR 6222G
C212	0.1 mfd/600V	Tubular, Molded Paper	S,	TM-1
C213	2.0 mfd/200V	Tubular, Metallized Paper	Astron,	MQC-2-2M
C214	40 mfd/450V	Dry Electrolytic	S,	TVA-24
C215	.01 mfd/400V	Tubular, Molded Paper	S,	TM-11-4
C216	.0062 mfd/300V	Mica	EM,	CM-35-622
C217	.02mfd/2000V	Tubular, Metal	S,	PX-122
C218	.005 mfd/1600V	Tubular, Paper	S,	MB-12
C219	.02 mfd/1600V	" "	"	"
C220	0.5 mfd/1000V	Bathtub	CD,	DYR 10050
C221	0.5 mfd/600V	Tubular, Metalized Paper	A,	P82 only

## ELECTRICAL PARTS LIST

### CAPACITORS - continued

SYMBOL	VALUE	DESCRIPTION	TYPICAL MFR'S. PART NO.	
C222	.005 mfd/600V	Tubular, Molded Paper	S,	TM-25
C223	1.0 mfd/600V	Oil	CD,	YAB 6100
C224	0.5 mfd/400V	Bathtub	S,	BP 50
C225	0.5 mfd/400V	Tubular, Molded Paper	S,	TM-5-4
C226	0.5 mfd/400V	" "	"	"
C227	0.1 mfd/600V	" "	S,	TM-1
C228	0.1 mfd/600V	" "	"	"
C229	0.1 mfd/600V	" "	"	"
C230	0.1 mfd/600V	" "	"	"
C231	.001 mfd/600V	Tubular, Metalized Paper	S,	TM-21
C232	.02 mfd/400V	Tubular, Molded Paper	S,	TM-12-4
C233	.02 mfd/400V	" "	"	"
C234	.002 mfd/1600V	" "	S,	MB-22
C235	.002 mfd/1600V	" "	"	"
C236	100 mmf/300V	Ceramic	ER,	GP-1K
C237	100 mmf/300V	"	"	"
C238	.01 mfd/400V	Molded Paper	S,	TM-11-4
C239	.01 mfd/400V	" " "	"	"
C240	.01 mfd/1600V	Tubular, Metalized Paper	S,	MB-11
C241	.003 mfd/600V	Molded Paper	S,	TM-23
C242	.01 mfd/200V	Tubular, Metalized Paper	A,	P82

### TUBES

<u>TUBE SYMBOL</u>	<u>TYPE</u>
V101	6AU6
V102	6BE6

## ELECTRICAL PARTS LIST

### TUBES - continued

<u>TUBE SYMBOL</u>	<u>TYPE</u>	
V103	6AU6	
V104	6AU6	
V105	12AX7	
V201	5U4G	
V202	5U4G	
V203	6AQ5	Tubes From Any Mfr.
V204	6AU6	
V205	6AQ5	
V206	6AU6	
V207	OA2	
V208	OA2	
V209	6AQ5	
V210	1B3GT	
V211	1B3GT	
V212	12AX7	
V213	12AX7	
V214	6D4	
V215	12AX7	
V216	12AU7	
V217	5CP1A	
V218	6AQ5	
V301	707B or 2K28	
V401	2K25	

## ELECTRICAL PARTS LIST

### INDUCTANCES

SYMBOL	VALUE	DESCRIPTION	TYPICAL MFR'S. PART NO.
L101		RF Choke	CTC, LB-3-30 h
L102		Slug Tuned Coil, 22.5 mc	V, Special
L103		Slug Tuned Oscillator Coil, 19.5 mc	" "
L104		Slug Tuned Coil, 3.0 mc	CTC, LSM-L-5MC
L105		" "	" "
L106		" "	" "
L107		RF Choke, 22.5 mc	V, Special
L108		RF Choke, 19.5 mc	" "
L109		RF Choke, 3.0 mc	" "
L110		" "	" "
L111		" "	" "
L201	16H	Choke, Filter	Stancor C-1420
L202	7H	Choke, Filter	Stancor C-1421

### TRANSFORMERS

T201		Power Transformer	" V. Special
T202		Oscillator Transformer	" "
T101		IF Input Transformer, 22.5 mc	" "

### RESISTORS

SYMBOL	VALUE	DESCRIPTION	TYPICAL MFR'S. PART NO.
R101	220 ohms 1/2W $\pm 10\%$	Composition Pigtail	IRC, Type BTS or O, "Little Devil"
R102	100 ohms	" " " "	" "
R103	22K	" " " "	" "

## ELECTRICAL PARTS LIST

### RESISTORS - continued

SYMBOL	VALUE	DESCRIPTION				TYPICAL MFR'S. PART NO.	
R104	10K	1/2W	+10%	Composition	Pigtail	IRC, Type BTS or O, "Little Devil"	
R105	470K	"	"	"	"	"	"
R106	22K	"	"	"	"	"	"
R107	6.8K	"	"	"	"	"	"
R108	18K	"	"	"	"	"	"
R109	470K	"	"	"	"	"	"
R110	4.7K	"	"	"	"	"	"
R111	100K	"	"	"	"	"	"
R112	220K	"	"	"	"	"	"
R113	10K	"	"	"	"	"	"
R114	470K	"	"	"	"	"	"
R115	1K	"	"	"	"	"	"
R116	100K	"	"	"	"	"	"
R117	220K	"	"	"	"	"	"
R118	10K	"	"	"	"	"	"
R119	470K	"	"	"	"	"	"
R120	22K	"	"	"	"	"	"
R121	47K	"	"	"	"	"	"
R122	47 ohms	"	"	"	"	"	"
R123	47 ohms	"	"	"	"	"	"
R124	470K	"	"	"	"	"	"
R125	470K	"	"	"	"	"	"
R201	510K	"	+5%	"	"	"	"
R202	3.3 Meg	"	+10%	"	"	"	"
R203	1K	"	"	"	"	"	"
R204	1K	"	"	"	"	"	"
R205	220K	"	"	"	"	"	"

## ELECTRICAL PARTS LIST

### RESISTORS - continued

SYMBOL	VALUE	DESCRIPTION	TYPICAL MFR'S. PART NO.
R206	100K 1/2W $\pm 10\%$	Composition Pigtail	IRC, Type BTS or O, "Little Devil"
R207	470K " "	" "	" "
R208	4.7K " "	" "	" "
R209	510K " $\pm 5\%$	" "	" "
R210	100K $\pm 20\%$ , Linear Pot.	Slotted Shaft	C, AM-49S
R211	240K 1/2W $\pm 5\%$	Composition Pigtail	IRC, Type BTS or O, "Little Devil"
R212	4.7K 1W " "	" "	" "
R213	1K 1/2W $\pm 10\%$	" "	" "
R214	1K " "	" "	" "
R215	470K " "	" "	" "
R216	47K " "	" "	" "
R217	150K " "	" "	" "
R218	470K " "	" "	" "
R219	160K " $\pm 5\%$	" "	" "
R220	100K $\pm 20\%$ , Linear Pot.	Slotted Shaft	C, AM-49S
R221	240K 1/2W $\pm 5\%$	Composition Pigtail	IRC, Type BTS or O, "Little Devil"
R222	2.5K 5W $\pm 10\%$	Wire Wound	S, Koolohm 5KT only
R223	50K $\pm 20\%$	Linear Potentiometer	C, AM-44-S
R224	12K 2R $\pm 10\%$	Composition Pigtail	AB, only
R225	100 ohms 1/2W " "	" "	IRC, Type BT or O, "Little Devil"
R226	100K " "	" "	" "
R227	270 ohms " "	" "	" "
R228	100K " "	" "	" "

## ELECTRICAL PARTS LIST

### RESISTORS - continued

SYMBOL	VALUE	DESCRIPTION	TYPICAL MFR'S. PART NO.
R230	270K 1/2W $\pm 10\%$	Composition Pigtail	IRC, Type BT or O, "Little Devil"
R231	500K $\pm 20\%$ , Linear	Potentiometer	C, AM-58-S
R232	39K 1/2W $\pm 10\%$	Composition Pigtail	IRC, Type BT or O, "Little Devil"
R233	50K $\pm 20\%$ , Linear	Potentiometer	C, AM-44-S
R234	22K 1/2W $\pm 10\%$	Composition Pigtail	IRC, Type BT or O, "Little Devil"
R235	1 Meg $\pm 10\%$ 2W	Potentiometer	AB, Type J, only
R236	270K 1/2W $\pm 5\%$	Composition Pigtail	IRC, Type BT or O, "Little Devil"
R237	68 ohms " $\pm 10\%$	" "	" "
R238	3.3 Meg. " "	" "	" "
R239	25K $\pm 10\%$ , Linear	Dual Potentiometer	C, D-37
R240	10K 1/2W $\pm 5\%$	Composition Pigtail	IRC, Type BT or O, "Little Devil"
R241	10K " "	" "	" "
R242	3.3 Meg " $\pm 10\%$	" "	" "
R243	560K 1W "	" "	" "
R244	560K 1W "	" "	" "
R245	10K 1/2W "	" "	" "
R246	3.3 Meg. " "	" "	" "
R247	330 ohms " "	" "	" "
R248	470K " "	" "	" "
R249	150K " "	" "	" "
R250	150K " "	" "	" "
R251	680K " "	" "	" "
R252	820K " "	" "	" "
R253	3.3 Meg. " "	" "	" "
R254	330 ohms " "	" "	" "

## ELECTRICAL PARTS LIST

### RESISTORS - continued

SYMBOLS	VALUE	DESCRIPTION	TYPICAL MFR'S. PART NO.
R255	2.4K 1/2W $\pm 5\%$	Composition Pigtail	IRC, Type BT or O, "Little Devil"
R256	6.8K " $\pm 10\%$	" "	" "
R257	1.2K " "	" "	" "
R258	10K " "	" "	" "
R259	3.3 Meg. " "	" "	" "
R260	50K $\pm 20\%$ , Linear	Potentiometer	C, AM-44-S
R261	82K 1/2W $\pm 5\%$	Composition Pigtail	IRC, Type BT or O, "Little Devil"
R262	82K " $\pm 5\%$	" "	" "
R263	250K $\pm 20\%$ , Linear	Potentiometer	C, AM-55-S
R264	270K 1W $\pm 5\%$	Composition Pigtail	IRC, Type BT or O, "Little Devil"
R265	270K " $\pm 5\%$	" "	" "
R266	22K 1/2W $\pm 10\%$	" "	" "
R267	1M " "	" "	" "
R268	470K " "	" "	" "
R269	1 Meg $\pm 20\%$ , Linear	Dual Potentiometer	C, DC-35-S
R270	3.3 Meg. 1/2W $\pm 10\%$	Composition Pigtail	IRC, Type BT or O, "Little Devil"
R271	3.3 Meg. " "	" "	" "
R272	3.3 Meg. " "	" "	" "
R273	3.3 Meg. " "	" "	" "
R274	3.3 Meg. " "	" "	" "
R275	3.3 Meg. " "	" "	" "
R276	3.3 Meg. " "	" "	" "
R277	3.3 Meg. " "	" "	" "
R278	1 Meg. $\pm 20\%$ , Linear	Dual Potentiometer	C, DC-35-S
R279	500K $\pm 20\%$ Linear	Pot., Single Slotted Shaft	C, AM-58-S

## ELECTRICAL PARTS LIST

### RESISTORS - continued

SYMBOL	VALUE	DESCRIPTION	TYPICAL MFR'S. PART NO.
R280	100 1/2W <u>+10%</u>	Composition Pigtail	IRC, Type BTS or O, "Little Devil"
R281	0.23 ohms*	Meter Shunt Resistor	V, Special
R282	150K 1/2W <u>+10%</u>	Composition Pigtail	IRC, Type BTS or O, "Little Devil"
R283	470K " "	" "	" "
R284	2.2 Meg. " "	" "	" "
R285	100K " "	" "	" "
R286	10K <u>+20%</u> Linear	Potentiometer Wire Wound	C, 43-10000
R287	1K 1/2W <u>+10%</u>	Composition Pigtail	IRC, Type BTS or O, "Little Devil"
R288	2.7M 1W <u>+10%</u>	" "	" "
R289	2.7M 1W <u>+10%</u>	" "	" "
R290	2.7M 1W <u>+10%</u>	" "	" "
R291	2.7M 1W <u>+10R</u>	" "	" "
R301	10K <u>+20%</u> Linear	Potentiometer Wire Wound	C, 43-10000
R401	10K <u>+20%</u> Linear	Potentiometer Wire Wound	C, 43-10000

### MISCELLANEOUS

SYMBOL	VALUE	DESCRIPTION	TYPICAL MFR'S. PART NO.
S201		SPST Power Switch	AHH, #20992
S203		DPDT Signal Switch	AHH, #81027
S204		SYNC Selector 3 Pos.	V, Special
S205		DPDT Meter Switch	AHH, #81027

\*Shunt chosen to make 0-1 ma meter read 45 ma full scale. A change in value of meter resistance will require a change in this value.

## ELECTRICAL PARTS LIST

### MISCELLANEOUS - continued

SYMBOL	VALUE	DESCRIPTION	TYPICAL MFR'S. PART NO.	
F201	5 amp	Fuse	L,	3AG
F203	0.1 amp/250V	Fusetron	B,	MDL
F204	0.2 amp/250V	"	"	"
CR201		IN34 Crystal	K,	---
CR301		IN21B Crystal	"	---
CR401		IN23B Crystal	"	---
M201	1-0-1 Ma. D. C.	Meter 1 1/2" round (10.3 ohms)	V,	Special
I201	6.8V 150ma	Pilot light bulb	GE,	#47 Size T-3 1/4
E101	8 terminals	Barrier Connection Strip	HBJ,	#8-140-Y

### FEMALE CONNECTORS

J101		Coaxial Connector	V,	Special
J201		Binding Posts & Insulators	M,	#37222-37202
J202		Octal Connector	AC,	78-PF-8-11
J301		Coaxial Connector	DC,	2073
J302		Coaxial Connector	DC,	2073
J401		Coaxial Connector	DC,	2073

### MALE CONNECTORS

P201		110V Male Plug with gnd. lead	Any	
P301		Octal Connector	AC,	23-1S/86-CP8
P302		Coaxial Connector	DC,	CBOK UG88U
P401		Octal Connector	AC,	23-1S/86-CP8
P402		Coaxial Connector	DC,	CBOK UG88U



## LIST OF MANUFACTURERS

<u>SYMBOL</u>	<u>MANUFACTURER</u>
EM	Electromotive Mfg. Co.
A	Aerovox Corp.
CD	Cornell Dublier Electric Corp.
S	Sprague Electric Co.
ER	Erie Resistor Co.
CTC	Cambridge Thermionic Co.
IRC	International Resistance Co.
O	Ohmite Mfg. Co.
C	Centralab, Div. of Globe Union Inc.
AB	Allen Bradley Co.
V	Vectron Inc.
AHH	Arrow-Hart & Hegeman Co.
CH	Cutler-Hammer Inc.
D	Dumont Laboratories Inc., Allen B.
L	Littlefuse Inc.
B	Bussman Mfg. Co.
K	Kemtron Electron Products, Inc.
GE	General Electric Co.
HBJ	Jones Div., Howard B., Cinch Mfg. Co.
M	Millen Mfg. Co., James
AC	American Phenolic Corporation
DC	Diamond Mfg. Co.



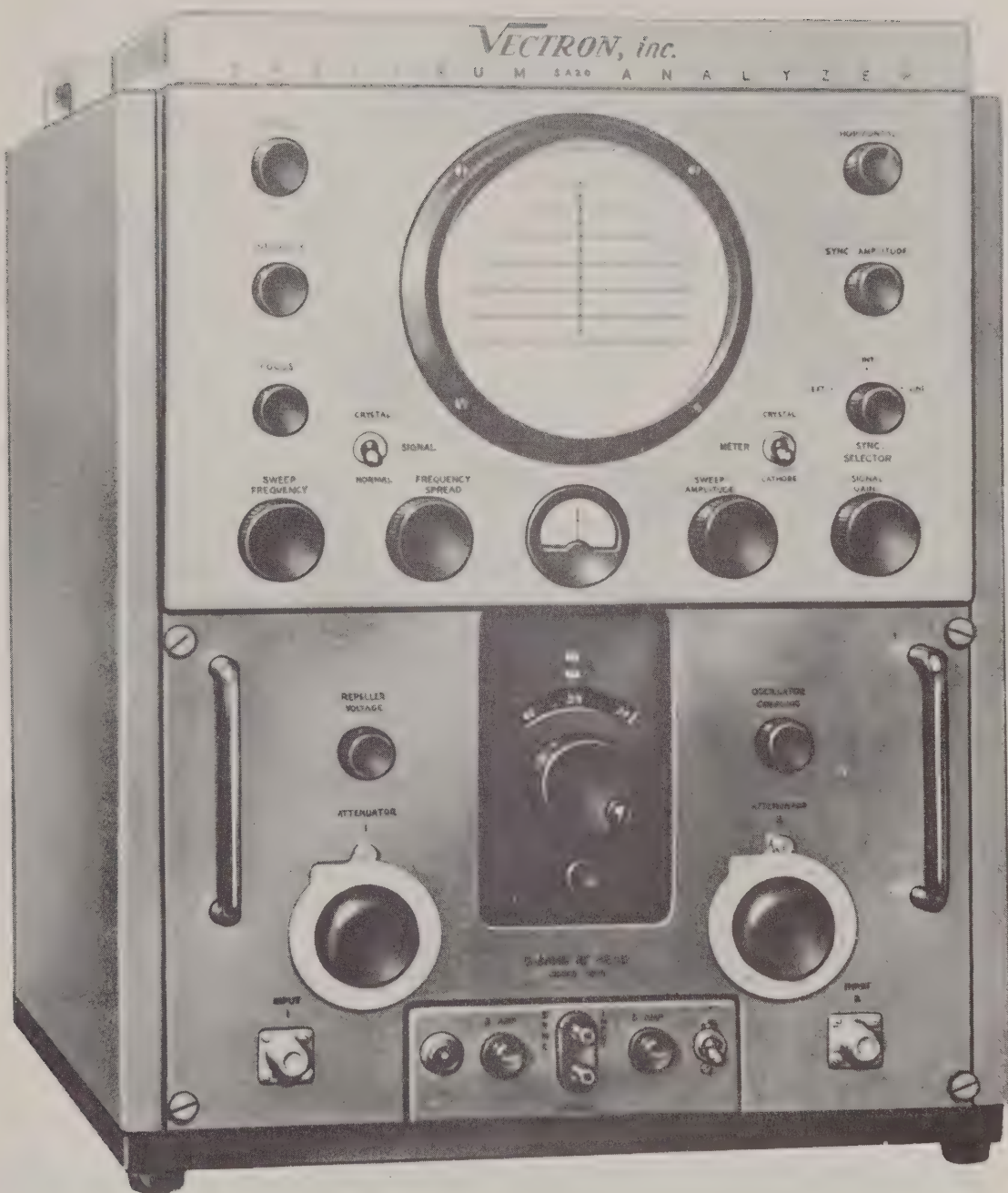


FIG. 1A FRONT VIEW, SPECTRUM ANALYZER  
(S-BAND HEAD)



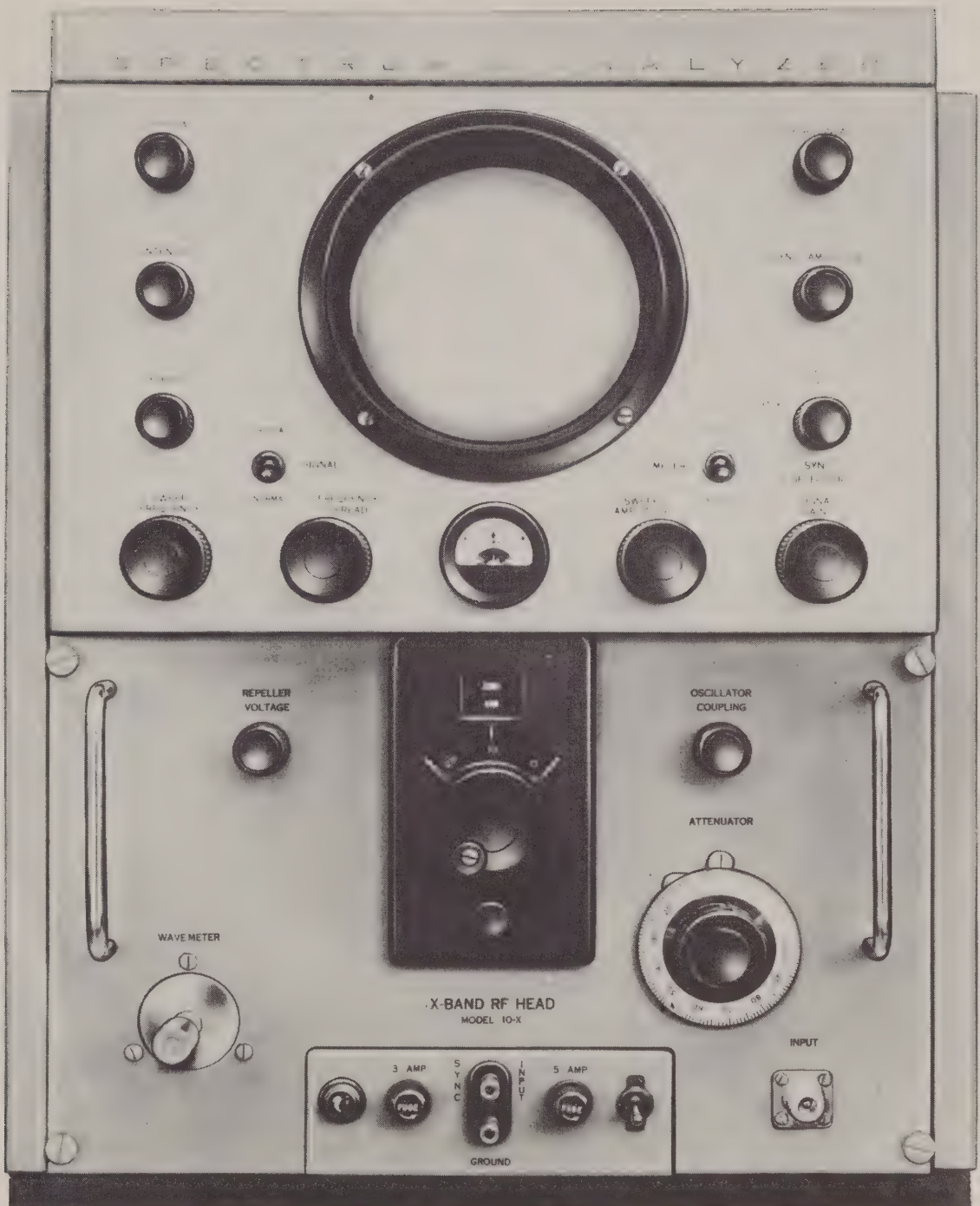


FIG. 1B FRONT VIEW, SPECTRUM ANALYZER  
(X-BAND HEAD)



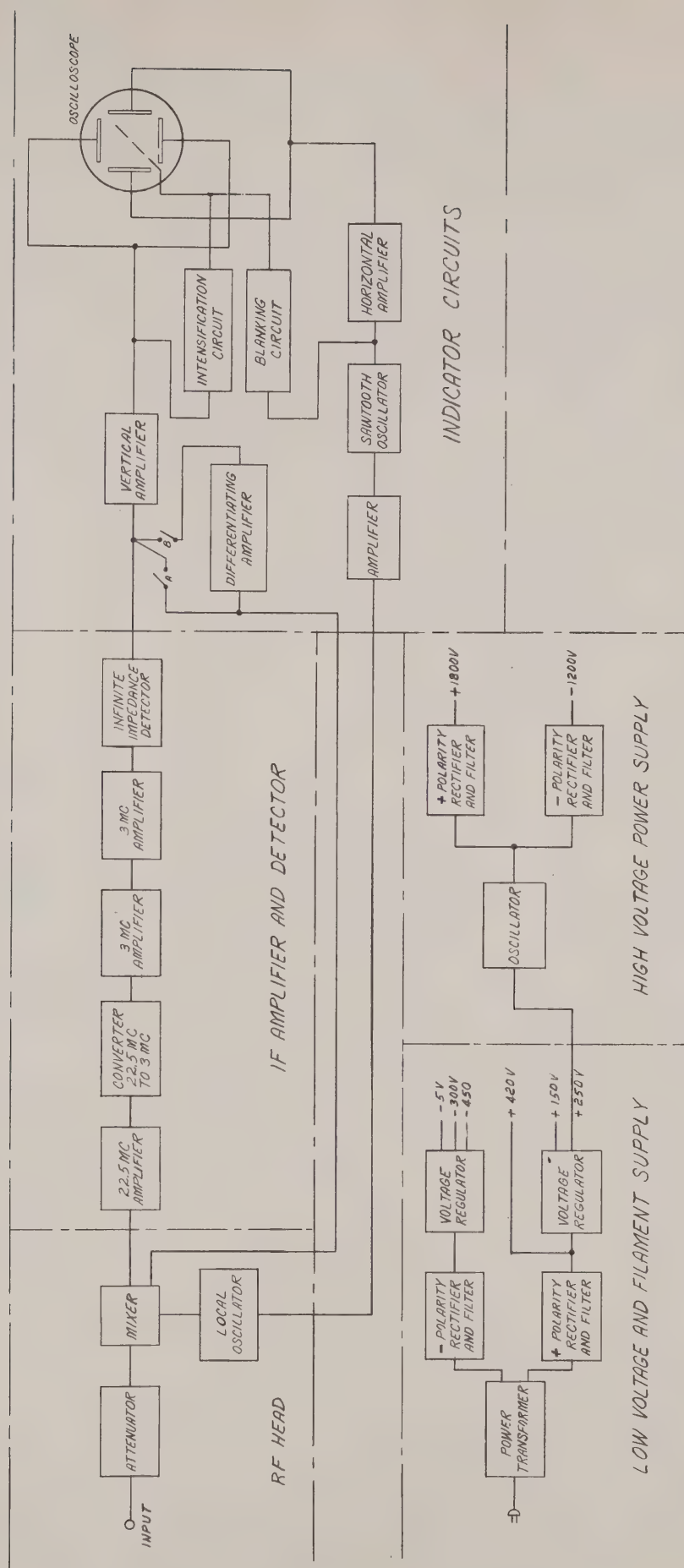
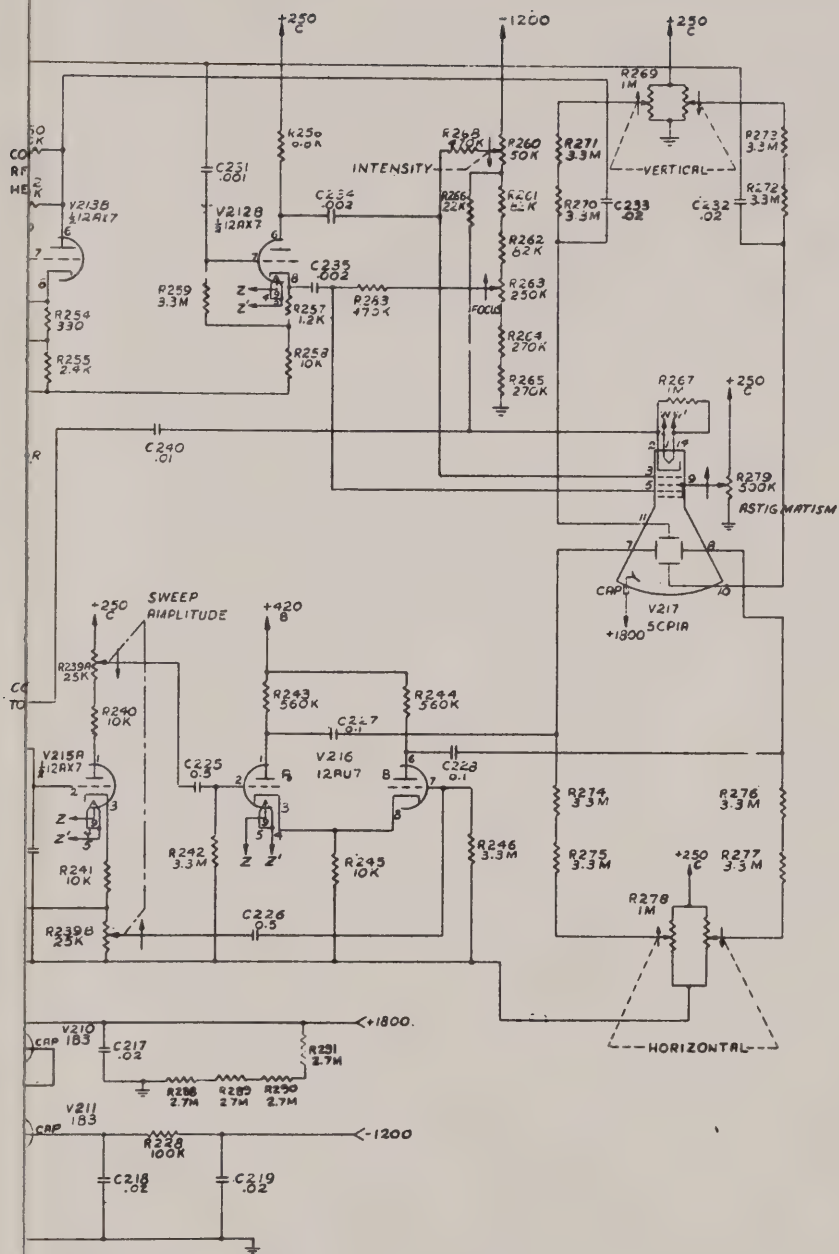


FIG. 2. BLOCK DIAGRAM, SPECTRUM ANALYZER







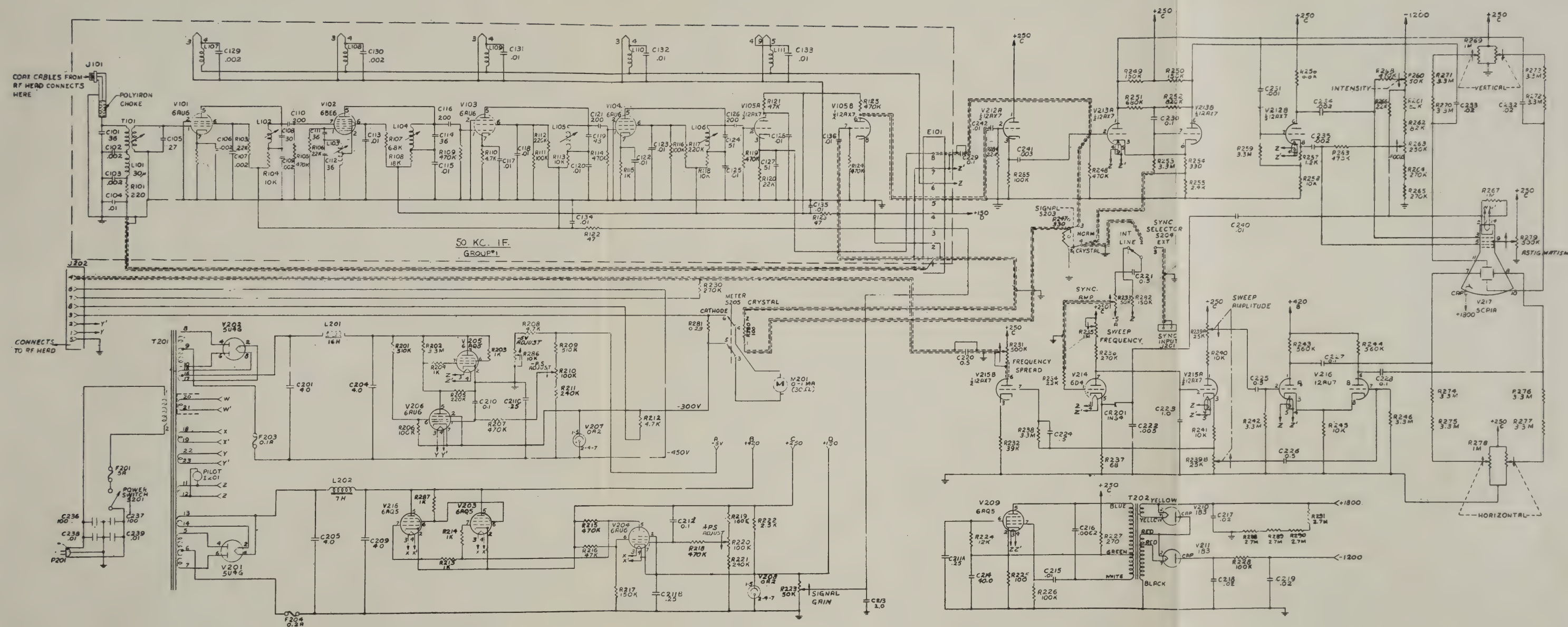


FIG. 3A SCHEMATIC DIAGRAM, SPECTRUM ANALYZER



20KC. I.F.  
GROUP 2

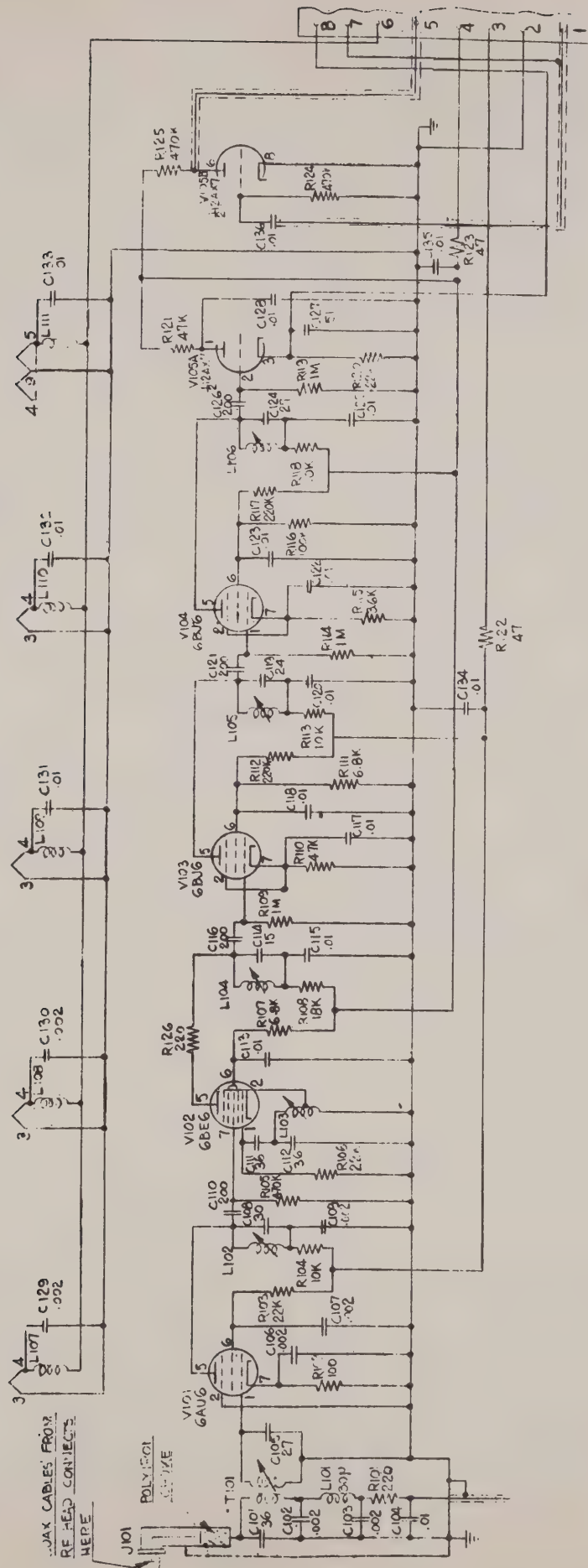


FIG. 3B 20KC I.F. STRIP



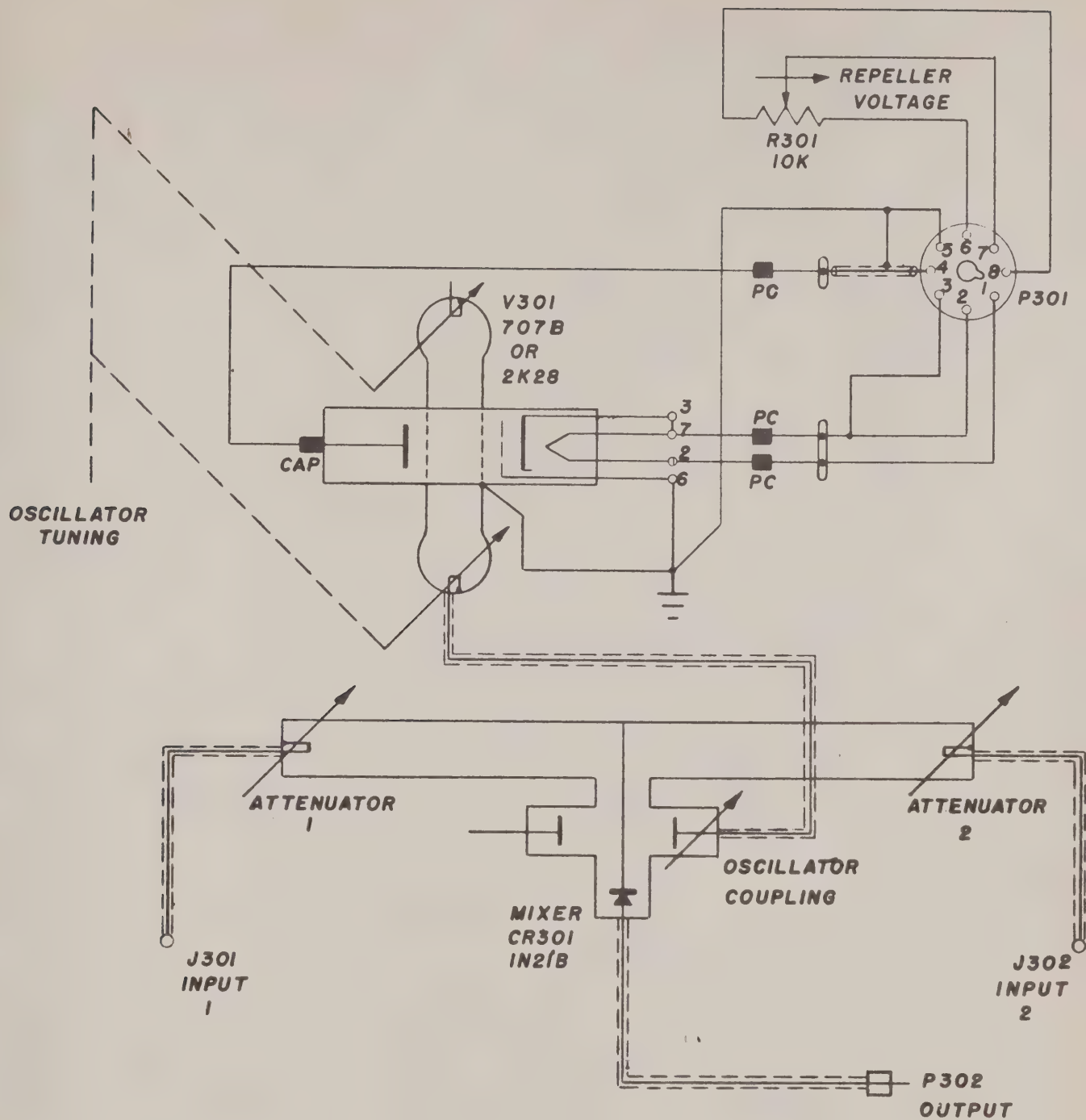
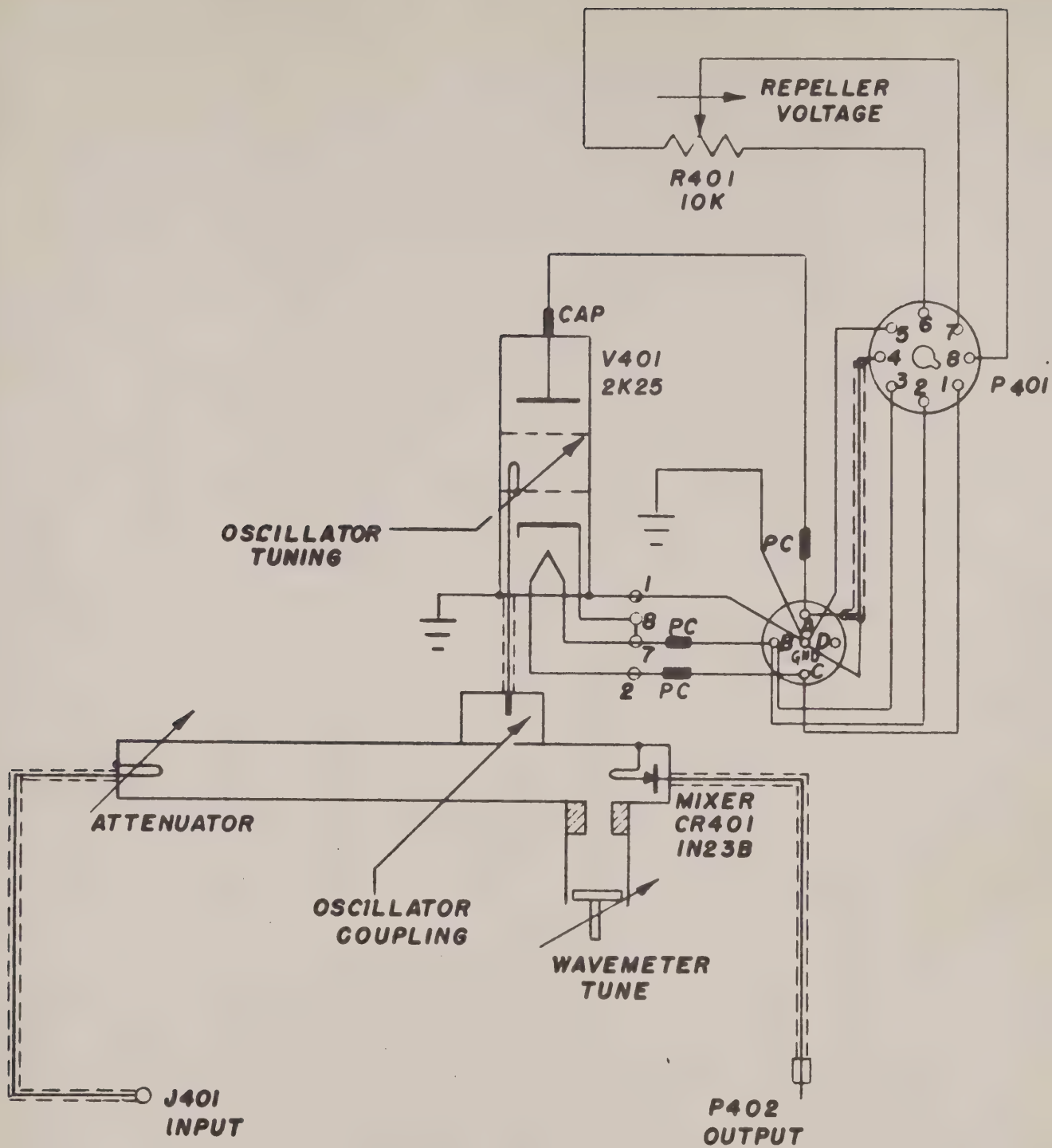


FIG. 4A SCHEMATIC DIAGRAM, S-BAND HEAD





PC = POLYIRON CHOKE

FIG. 4B SCHEMATIC DIAGRAM, X-BAND HEAD



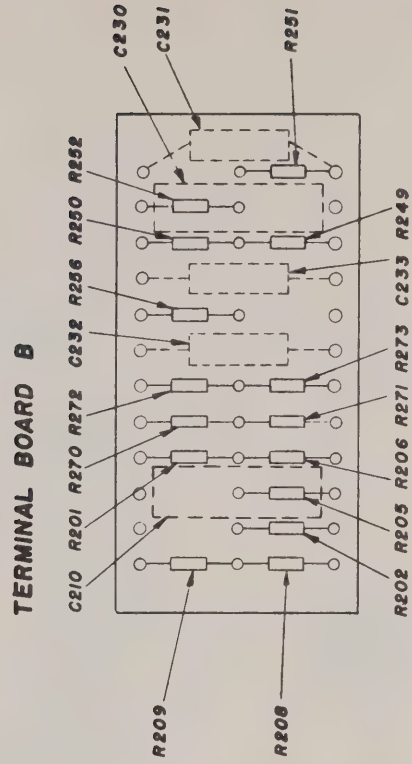
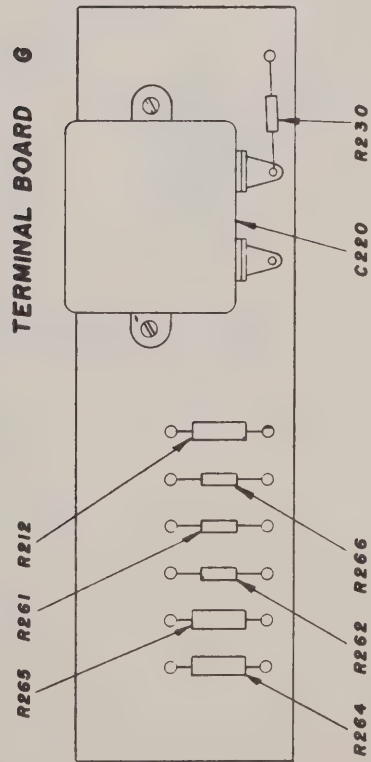
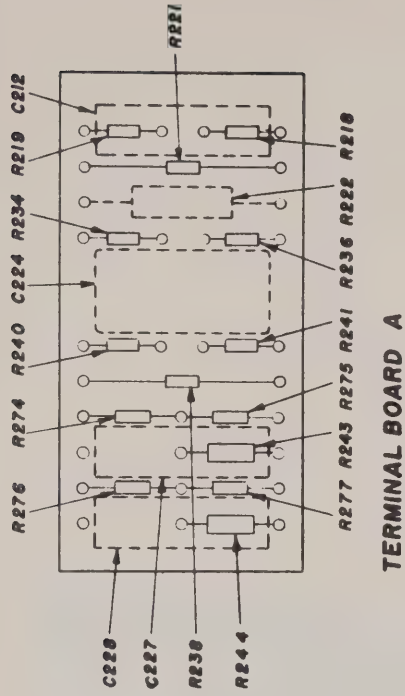
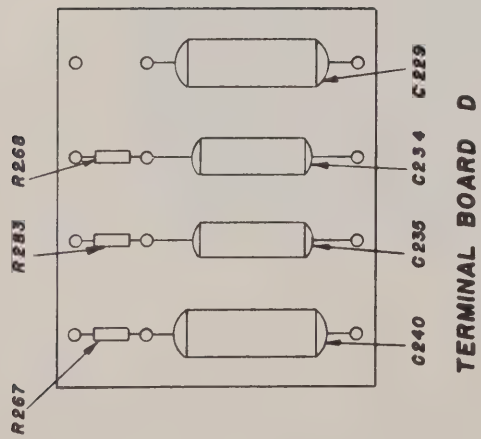


FIG. 5 TERMINAL BOARDS, ANALYZER UNIT



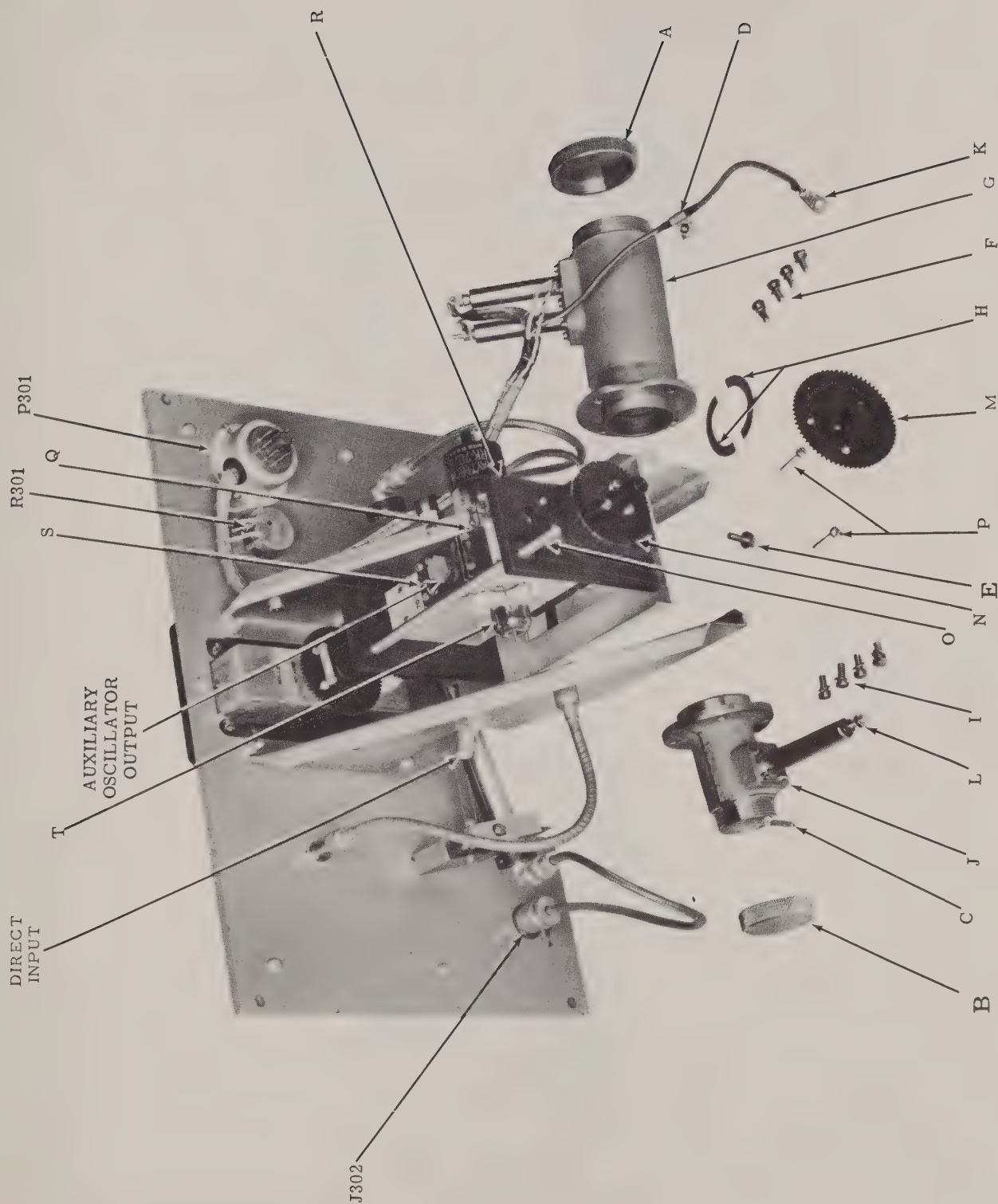


FIG. 6 KLYSTRON REMOVAL, S-BAND HEAD



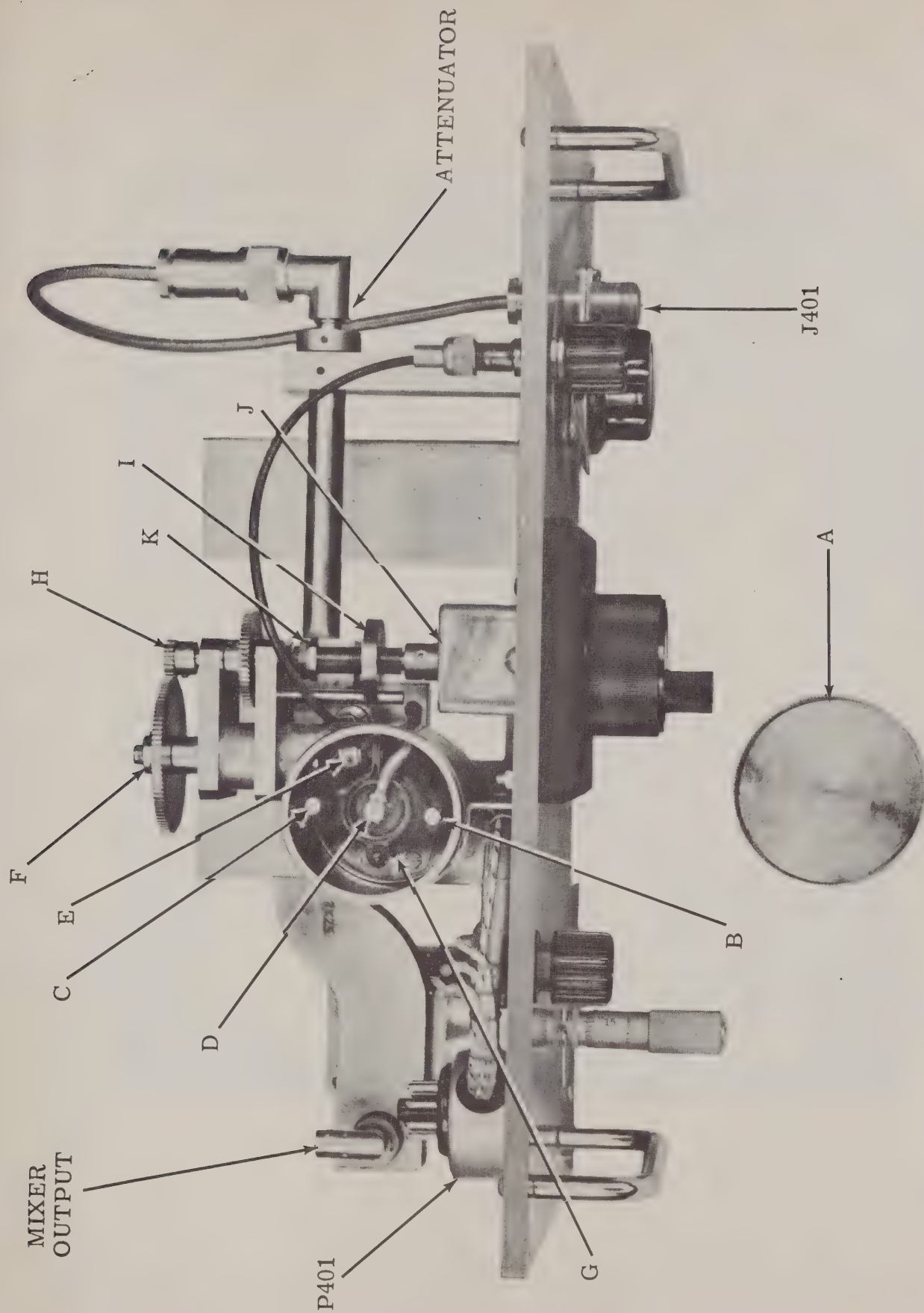


FIG. 7 KLYSTRON REMOVAL, X-BAND HEAD



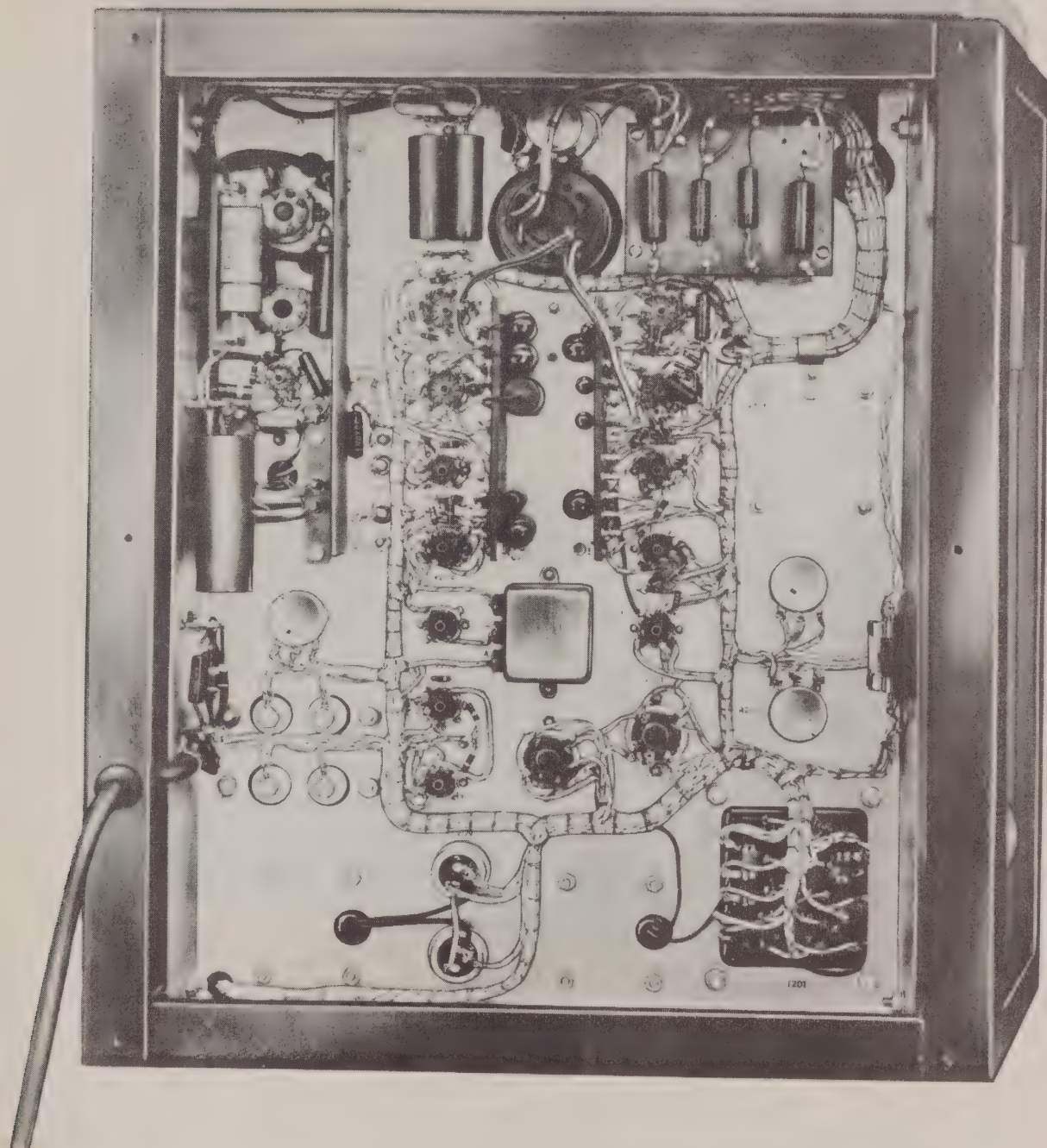


FIG. 8 REAR VIEW OF ANALYZER UNIT, BACK COVER REMOVED



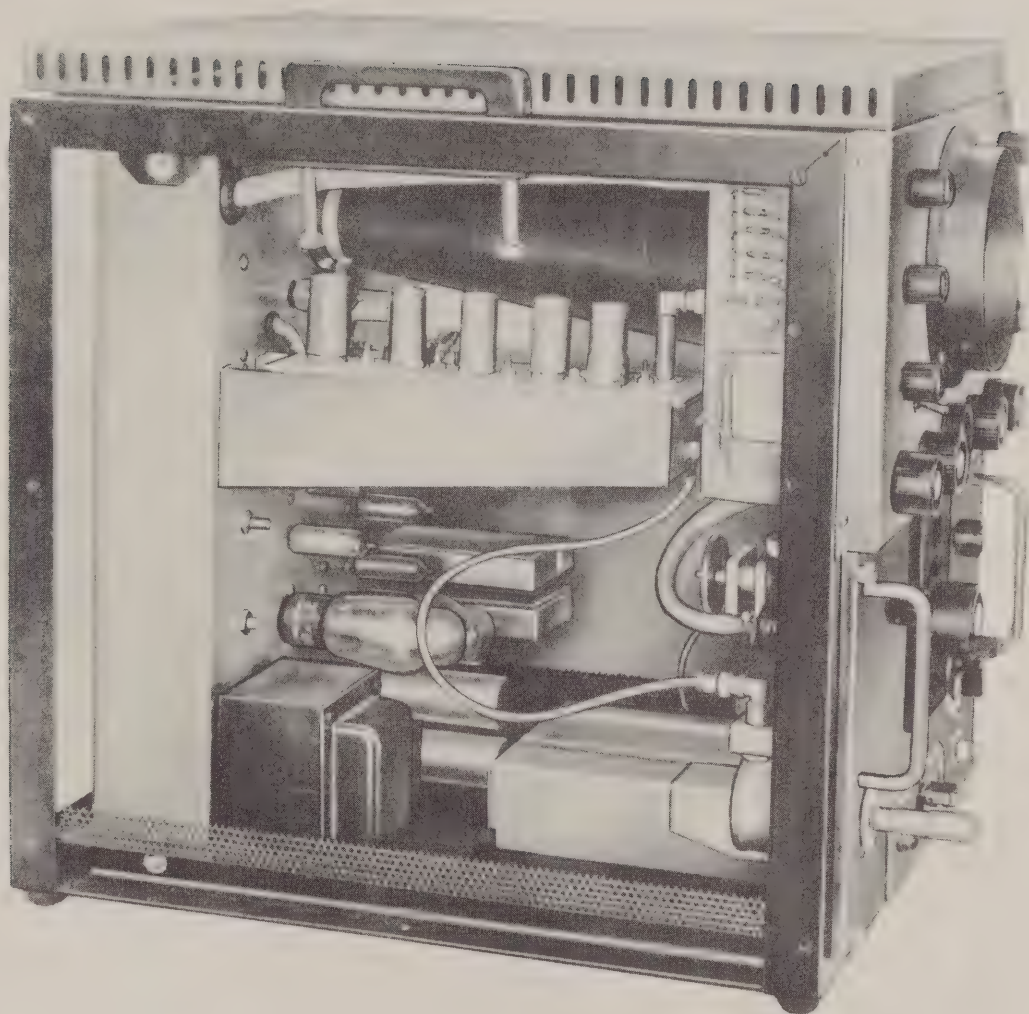


FIG. 9 SIDE VIEW OF ANALYZER UNIT, SIDE COVER REMOVED



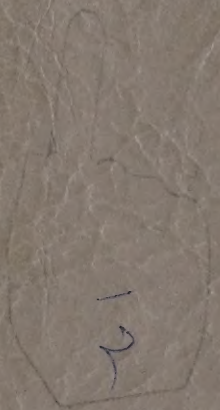
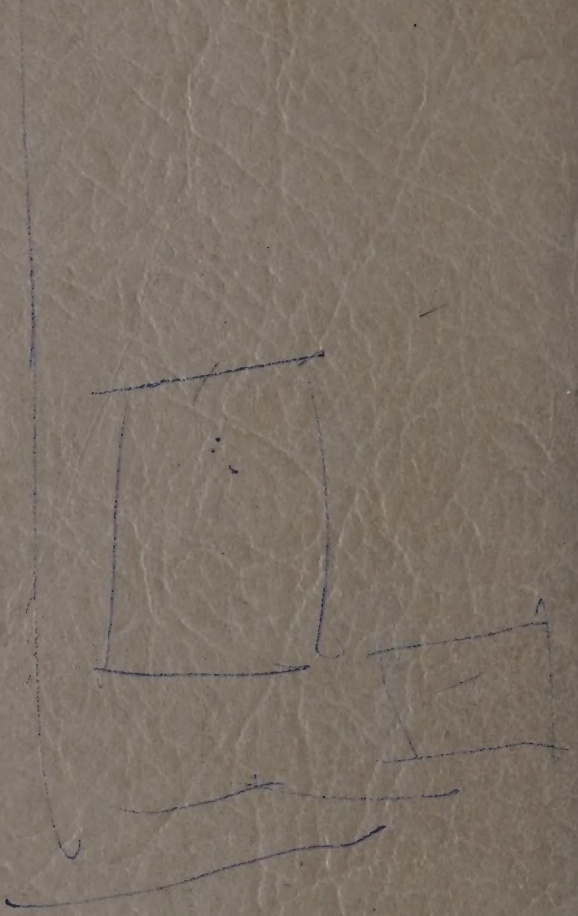
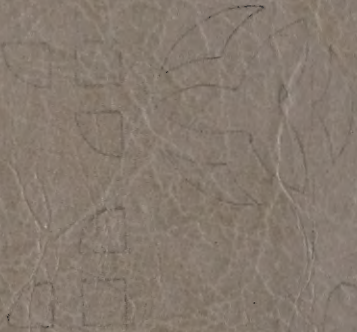
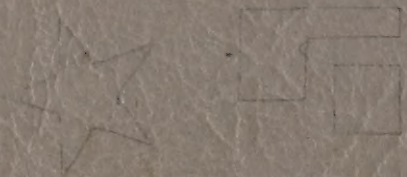
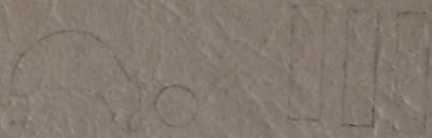
## NOTICE

Addenda sheets relating to newly-developed auxiliary-equipment, technical changes and special measurement techniques may be issued from time to time.

To ensure receipt of these sheets, the individual holders of Instruction Books should register with Vectron, Inc.







Handwritten text in blue ink, possibly a signature or date, consisting of several loops and a vertical line.

